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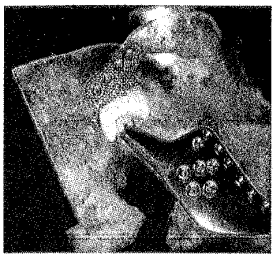

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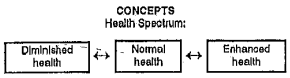

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■ BEHAVIORAL SCIENCES

The Prevalence of Some Joint Disorders in Craniomandibular Disorder (CMD) and Bruxers as Compared to CMD Nonbruxer Patients and Controls

Omar Franklin Molina, D.D.S., M.S.; Jose dos Santos, Jr., D.D.S., M.S.

ABSTRACT: The objective of this study was to assess and compare the frequency of some joint disorders in 130 CMD+bruxing behavior patients, 66 CMD/nonbruxing behaviors patients referred for diagnosis and treatment to the Center for the Study of Craniomandibular Disorders and 130 control subjects seeking routine dental care. Both patients and controls were consecutive referrals to the clinic occurring over a five year period. The mean age of the CMD+bruxing behavior group was about 35.48 years (range 14-54, SD = 8.45), and 36.84 years (range 17-60, SD = 9.30) in the 66 CMD nonbruxing behavior group, and 34.34 years (range 14-62, SD = 9.92) in the control group of 130 subjects. Information gathered included a questionnaire, history of signs and symptoms, and a clinical examination. Different types of joint disorders, muscle signs and symptoms and bruxing behavior were assessed in the CMD groups and in the corresponding control group. The study concluded that capsulitis/synovitis, retrodiskal pain and disk-attachment pain predominated in CMD+bruxing behavior patients. The data reinforces the need to assess CMD+bruxing behavior patients to evaluate signs and symptoms of such disorders in order to obtain additional information about the true source of pain and the need for proper management.

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Dr. Omar Franklin Molina received his D.D.S. degree in 1978 from the State University, Rio Grande do Sul, Brazil. He completed graduate studies at the State University of Santa Catarina, Brazil, receiving an M.S. degree in 1983. In 1983-1984 he specialized in orthodontics at the State University, Rio de Janeiro, Brazil and then attended advanced courses in occlusion and CMD in the United States. Dr. Molina has been a member of the American Equilibration Society since 1987 and has lectured on occlusion, facial pain and parafunctional habits in Brazil. He has published two book and is currently an instructor of advanced courses in CMD at The Brazilian Institute of Orthodontics, Rio de Janeiro, Brazil. Dr. Molina is a member of The Center for Study of Craniomandibular Disorders at Porto Alegre, Brazil.

Although there are a number of complaints which craniomandibular disorder and bruxer patients present when they first come for diagnosis and treatment, pain is by far the most prevalent symptom. Other common complaints of craniomandibular disorder (CMD) patients include impaired range-of-motion, different types and degrees of joint noises, and tenderness to palpation in major masticatory muscles. Pain may arise from many sources in the masticatory system and treatment may vary significantly according to the pain's location and to the contributing, triggering and sustaining factors; therefore, identifying the true source of pain remains a vital component of the examination and diagnostic process. TMJ (temporomandibular joint) pain arises in those structures that are innervated and vascularized, mainly the bilaminar zone, joint capsule, disk attachments, synovial complex, and the region located between the anterior part of the disk and the insertion of the upper lateral pterygoid muscle.

Even though there are many areas in the temporomandibular joint where inflammation occurs, inflammatory conditions are usually subdivided into synovitis and capsulitis. Synovitis refers to intracapsular inflammation primarily affecting the posterior attachment, whereas capsulitis refer to inflammation of the structures

primarily comprising the joint capsule.[1] Capsulitis are characterized by palpable tenderness or pain directly over the condyle and/or minor swelling over the joint. Capsular pain is the result of inflammation of the fibrous capsule and inner synovial lining. It may be induced when the inflamed capsule is stretched which occurs when the patient performs a vertical border jaw movement. Clinical studies about capsulitis/synovitis and disk attachment pain in CMD+bruxers and CMD-nonbruxer patients are lacking.

The studies performed by Farrar[2,3] heralded a new avenue of rich research about internal joint derangements (IJD) which has contributed to elucidate some pathophysiologic mechanisms associated with the internal derangement process. Although the literature on IJD is very rich, epidemiologic and clinical studies about some specific joint disorders, namely capsulitis/synovitis, retrodiskal pain and disk attachment pain, are scarce. A number of studies about disk disorders have been carried out[4-6] in the last few years, and MRI is the most useful tool to provide a clearer understanding of such disorders. The prevalence of some myogenic and arthrogenous disorders was assessed recently[7]; however, the prevalence of other joint disorders which are thought to predominate in CMD patients remains obscure. There is agreement in the literature that patients with signs and symptoms of CMD may be clustered into subgroups suffering from this same disorder with mainly a myogenous component, internal derangements with and without reduction, and osteoarthrosis.[3] On the other hand, it is also important to recognize how specific joint disorders are represented in the population of CMD patients. If the prevalence of capsulitis/synovitis is very high, then diagnostic tools and therapeutic approaches should be developed to treat the condition. It is unfortunate that most studies about joint disorders have focused on "disk derangements," whereas other common clinical complaints that occur independently or concomitantly have been ignored.

A patient presenting signs and symptoms of myofascial pain dysfunction syndrome (MPDS), nocturnal bruxing behavior, and disk attachment pain, should not be treated in the same way as a patient presenting mild bruxing behavior and masticatory pain. It follows that the identification of the set of disorders he or she presents is mandatory. TMD signs and symptoms may occur in different combinations and gradations in the muscles, joints, teeth, tendons, ligaments and other structures including the head and ears. Symptoms occurring solely in the temporomandibular joints may also occur in different combinations, gradations and stages. There seems to be evidence from clinical experience that the more chronic a complaint from the TMJs, the more likely the patient may present a combination of joint disorders (e.g., capsulitis/synovitis, disk displacement with and without reduction, and disk attachment pain combined with behavioral disorders such as bruxism and/or clenching).

Most investigations about TMD have only reported the prevalence of general signs and symptoms in different population groups, particularly those presenting pain and dysfunction. When investigating the prevalence of TMJ internal derangements, most, if not all researchers, have focused on disk disorders without emphasizing other joint disorders. The prevalence of a disorder can be investigated by using symptom description, the anatomical structures involved, etiologic and pathophysiologic mechanisms,[9] and the use of diagnostic tests. The presence of an anatomic disorder such as an intra-articular problem is best determined via direct examination. In the case of TMJ pathology, arthrotomography, CT scans and MRI scans are available. Routines use of invasive and/or expensive procedures such as arthrotomography and MRI are not realistic; such techniques should be preserved for difficult and/or confusing diagnostic cases and for research purposes.[10]

CMD therapy should only be established in patients according to the type, grade, combination of temporomandibular disorders, chronicity, psychological aspects and other clinical and behavioral features. The plan of treatment of patients should be designed based on a group of characteristics rather than on the general label of "facial, joint, or muscle pain." Therefore, when treating TMD signs and symptoms, it is important to know if we are treating a disk disorder, a capsulitis/synovitis case, a disk attachment or a combination of disorders. It is inadequate to treat a patient presenting disk attachment pain combined with a bruxing behavior in the same way as we treat a patient presenting an acute masticatory disorder or even a myofascial pain dysfunction syndrome.

Taking into consideration these facts, this study was designed to:

1. Assess the prevalence of some joint disorders (capsulitis/synovitis, retrodiskal pain, disk-attachment pain, disk displacement with and without reduction and osteoarthrosis in a group of CMD+bruxing behavior patients as compared to a CMD-nonbruxing behavior group and a control group.
2. Compare the prevalence of capsulitis/synovitis, retrodiskal pain and disk attachment pain in CMD+bruxers and CMD-nonbruxers. It has been suggested that repetitive bruxing behavior and/or clenching causes stretching of the joint capsule followed by inflammation and pain, pressure on the retrodiskal tissues followed by retrodiskitis, pressure on the periphery of the disk, vacuum, and adhesions

leading to disk attachment pain and episodes of intermittent or transient locking. It is expected the CMD and bruxers/clenchers patients as a group present a higher prevalence of these disorders as compared to CMD and nonbruxers and controls.

Materials and Methods

Information about the frequency of signs and symptoms of CMD, some specific joint disorders and bruxing behavior were gathered from three different populations. The first group (a CMD and bruxing behavior group), consisted of 130 patients who had been referred consecutively to the Center for the Study of CMD and Facial Pain for assessment and treatment. There were 118 females and 12 males in the group, the mean age was 35.48 years old (range 14-54, SD = 8.45) (**Table 1**). As a whole the groups presented a number of signs and symptoms of CMD and bruxing behavior determined with the use of a questionnaire, taking a history of signs and symptoms, a clinical examination, an evaluation of jaw movements, palpation for tenderness of the joints and masticatory muscles, and use of diagnostic tests. Panoramic, transcranial tomographies, as well as MRI was requested when necessary to complement examination and diagnosis.

The second group (a CMD-nonbruxing behavior group), consisted also of CMD patients who did not fulfill the criteria to be considered as bruxers according to a specific protocol designed to assess the presence of signs and symptoms associated to bruxing and/or clenching behavior. After initial examination, patients in this group responded to a questionnaire, reported the history of signs and symptoms, were examined clinically and their masticatory muscles and TMJs palpated. There were 66 patients in this group (56 females and 10 males), ages ranged from 17-66 years old, mean age 36.84 years, SD = 9.30. CMD+bruxing behavior and CMD-nonbruxing behavior (**Table 1**). These patients had been referred over a period of five years prior to intervention for this study.

The third group (Control) was formed by 130 subjects referred consecutively to the same center for routine dental treatment. There were 103 females and 27 males, the mean age of this group was 34.34 years, range 14-62, SD = 9.92 (**Table 1**). The same procedure used to depict signs and symptoms of CMD applied to CMD+bruxer patients and CMD-non bruxer patients were used in the control group.

Specific criteria to include patients in the CMD groups:

1. Patients' history of chronic or acute pain in or around the TMJ;
2. Presence of muscle pain according to the history of signs and symptoms or elicited during palpation;
3. History of joint noises during jaw function; and
4. Difficulties to perform functional jaw movements.

Patients in the CMD groups (bruxers or nonbruxers) were seeking active treatment for their symptoms. Some patients had been taking self-prescribed drugs, including analgesics and myorelaxants to reduce muscle, joint and/or headache pain before the first visit for examination and diagnosis. Patients were listed in the CMD groups (bruxers or nonbruxers) if they demonstrated two or more of the four signs and symptoms listed above.

Patients were also included in the CMD+bruxer group (130 patients) if they demonstrated three or more of the following signs and symptoms:

1. Presence of wear facets of the teeth;
2. Recent history (last six months) of noise associated with nocturnal teeth grinding;
3. Patient's report that he or she catches himself or herself clenching the teeth during the day;
4. Patients' report of a chronic feeling of tension, stiffness, fatigue and/or tightness of the masseter muscle especially upon awakening in the morning; and
5. Hypertrophy of the masseter and/or temporalis muscle.

Specific criteria to include subjects in the Control Group:

1. They were not seeking active treatment for orofacial pain or dysfunction;
2. They were medication free; and

Table 1
Characteristics of CMD+Bruxing Behavior, CMD-Nonbruxing Patients and Control Subjects

	CMD+bruxers N = 130				CMD-nonbruxers N = 66				Controls N = 130			
	Fem	%	Male	%	Fem	%	Male	%	Fem	%	Male	%
Sex	118	90.77	12	9.23	56	84.85	10	15.15	103	79.23	27	20.77
Mean age	35.48				36.84				34.34			
Range	14-54				17-66				14-62			
SD	8.45				9.30				9.92			

3. Only minor signs and symptoms, such as joint noises associated to degenerative joint disease and muscle pain elicited during palpation, could be present in the group as a whole.

Specific criteria for capsulitis/synovitis (patients and controls):

Specific criteria was used to consider whether CMD+bruxing behavior patients, CMD-nonbruxing behavior patients and Control subjects were suffering from capsulitis/synovitis, as suggested by Bell.[11]

1. Pain on palpation over the lateral portion of the joint capsule upon opening and closing;
2. Pain elicited in a few seconds during forceful or border-sustained opening of the jaw;
3. Such pain could be arrested in seconds by having the patient occluding the teeth forcefully in the maximal intercuspal position.

Specific criteria for retrodiskal pain (patients and controls):

Other specific criteria were applied to consider patients (CMD+ bruxing behavior, CMD-nonbruxing behavior and Control subjects) were suffering retrodiskal pain as delineated by Bell:[11]

1. The pain could be elicited in seconds by pressing the upper and lower teeth in the maximal intercuspal position;
2. Such pain could be arrested in seconds by having the patient occluding his/her teeth against two cotton rolls placed over the posterior teeth.
3. Palpation with the minor finger over the posterior area of the TMJ (via external auditory meatus), could elicit pain, usually described as mild.

Specific criteria for disk attachment pain (patients and controls):

Specific criteria were also used to consider if CMD patients (bruxers and nonbruxers) and control subjects, presented symptoms of disk attachment pain as suggested by Bell:[11]

1. A patient's history and/or description of an intermittent pain in the joint;
2. Disk interference during opening;
3. Pain and gross joint noises during opening;
4. Limitation of mouth opening, history of progressive difficulties to open and/or close the lower jaw;
5. Patients could correlate their pain to jaw movements and functions including talking, eating and yawning;
6. History of previous stages of joint disorders.

Specific criteria for disk displacement with and without reduction (patients & controls):

The following specific criteria were used to consider whether patients and subjects presented disk displacement with or without reduction:

With reduction:

1. Clicking or popping sounds on opening and closing;
2. Normal or increased range of jaw opening;
3. Pain may or may not be present.

Without reduction:

1. Obvious limitation of mouth opening (less than 35mm);
2. Acute pain;
3. Gross joint noises;
4. Patients were able to correlate their pain with some specific traumatic event such as a motor vehicle accident (MVA), a blow to the face, and/or a medical procedure for oral surgery;
5. Placing the mandible in a protrusive position could increase jaw opening and reduce joint noises temporarily;
6. Inability of the patient to perform a contralateral jaw movement.

Specific criteria to consider patients and controls as presenting osteoarthrosis (OA):

1. A Patient's or subject's report of crepitation in the joint;
2. Confirmation of a such report by digital palpation followed by the use of a stethoscope to assess the quality of the noise into the joint;
3. Histories of previous stages of internal derangement, e.g., pain, clicking and/or difficulty opening the mouth;
4. Pain in the area of the joint (optional);
5. History of macro trauma to the joint or face (optional).

Results

The quantification of the subjective and objective data of this study is shown in **Tables 2, 3, 4, 5, 6** and **7**.

Table 2 shows that 125 (96.15%) CMD+bruxing behavior patients presented capsulitis/synovitis as compared to 58 patients (87.88%) in the CMD-nonbruxing behavior group and to 76 subjects (58.45%) in the control group. Percentages across groups concerning the presence of bilateral, right and left sides capsulitis/synovitis, in bruxing and nonbruxing behavior patients, presented highly significant value ($p < 0.001$) as compared to the control group (**Table 8**).

Table 3 demonstrates that 40 patients (30.76%) in the CMD+bruxing behavior group, three patients (4.54%) in the CMD-nonbruxing behavior group and two subjects (1.54%) in the control group presented signs and symptoms of retrodiskal pain according to established criteria. In this group, the incidence of the problem was significantly higher in the bruxing behavior patients ($p < 0.001$) as compared to the control group (**Table 9**).

Table 2
Frequency of Capsulitis/Synovitis in the CMA+Bruxing Behavior, CMD-Nonbruxing and Control Group

	CMD+bruxers N = 130		CMD-nonbruxer N = 66		Control N = 130	
	n	%	n	%	n	%
Capsulitis/synovitis (bilateral)	89	68.46	29	43.94	33	25.38
Capsulitis/synovitis (right side)	6	4.61	9	13.64	9	6.92
Capsulitis/synovitis (left side)	30	23.08	20	30.30	34	26.15
Totals	125	96.15	58	87.88	76	58.45

Table 3
Frequency of Retrodiskal Pain in the CMA+Bruxing Behavior, CMD-Nonbruxing and Control Group

	CMD+bruxers N = 130		CMD-nonbruxer N = 66		Control N = 130	
	n	%	n	%	n	%
Retrodiskal pain (bilateral)	16	12.30	0	0	0	0
Retrodiskal pain (right side)	10	7.69	1	1.51	1	0.77
Retrodiskal pain (left side)	14	10.77	2	3.03	1	0.77
Totals	40	30.76	3	4.54	2	1.54

Table 4 demonstrates that 50 patients (38.45%) in the CMD+bruxing behavior group, ten patients (15.14%) in the CMD-nonbruxing behavior group, and seven subjects (5.39%), in the control group presented signs and symptoms of disk-attachment pain. Again, the prevalence of the condition in the bruxing behavior group was significantly higher ($p < 0.001$) as compared to the control group (**Table 10**). **Table 5** demonstrates that 51 patients (39.23%) in the CMD+bruxing behavior group, 18 patients (27.27%) in the CMD-nonbruxing behavior group, and 36 subjects (27.69%) in the control group presented signs and symptoms of disk displacement with reduction. The percentage across groups for bilateral, right- and left-side disk displacements with reduction did not show a statistical difference ($p = 0.09$) when dysfunctional and nondysfunctional groups were compared (**Table 11**). This was an indication that the condition affected equally all patient and subject populations.

Table 6 shows that only eight patients (6.16%) in the CMD+bruxing behavior group presented signs and symptoms of disk displacement without reduction. Such a disorder was not observed either in the CMD-nonbruxing behavior group or in the control group. The results as statistically analyzed showed a highly significant difference

Table 4
Frequency of Disk-attachment Pain in the CMA+Bruxing Behavior, CMD-Nonbruxing and Control Group

	CMD+bruxers N = 130		CMD-nonbruxer N = 66		Control N = 130	
	n	%	n	%	n	%
Disk-attachment pain (bilateral)	20	15.38	2	3.03	2	1.54
Disk-attachment pain (right side)	11	8.46	3	4.54	4	3.08
Disk-attachment pain (left side)	19	14.61	5	7.57	1	0.77
Totals	50	38.45	10	15.14	7	5.39

Table 5
Prevalence of Disk Displacement Pain With Reduction in the CMA+Bruxing Behavior, CMD-Nonbruxing and Control Group

	CMD+bruxers N = 130		CMD-nonbruxer N = 66		Control N = 130	
	n	%	n	%	n	%
Disk-displacement w/reduction (bilateral)	24	18.46	4	6.06	11	8.46
Disk-displacement w/reduction (right side)	10	7.69	5	7.56	10	7.69
Disk-displacement w/reduction (left side)	17	13.08	9	13.64	15	11.54
Totals	51	39.23	18	27.27	36	27.69

Table 6
Prevalence of Disk Displacement Without Reduction in the CMA+Bruxing Behavior, CMD-Nonbruxing and Control Group

	CMD+bruxers N = 130		CMD-nonbruxer N = 66		Control N = 130	
	n	%	n	%	n	%
Disk-displacement w/o reduction (bilateral)	3	2.31	0	0	0	0
Disk-displacement w/o reduction (right side)	3	2.31	0	0	0	0
Disk-displacement w/o reduction (left side)	2	1.54	0	0	0	0
Totals	8	6.16	0	0	0	0

($p < 0.002$) between the bruxing behavior group and the control group (**Table 12**). However, these results suggested a very low incidence of the problem in our population of patients and subjects.

Table 7 shows that 13 patients (10.01%) in the CMD+ bruxing behavior group, five patients (7.57%) in the CMD-nonbruxing behavior group, and six subjects (4.62%) in the control group presented signs and

Table 7
Prevalence of Osteoarthrosis in the CMA+Bruxing Behavior, CMD-Nonbruxing and Control Group

	CMD+bruxers N = 130		CMD-nonbruxer N = 66		Control N = 130	
	n	%	n	%	n	%
Osteoarthrosis (bilateral)	8	6.16	2	3.03	2	1.54
Osteoarthrosis (right side)	4	3.08	1	1.51	2	1.54
Osteoarthrosis (left side)	1	0.77	2	3.03	2	1.54
Totals	13	10.01	5	7.57	6	4.62

Table 8
Capsulitis/Synovitis
Table of Location By Group

Location / Frequency / Col Pct	Group CMD+B	CMD-NB	Control	Total
None	5	8	54	67
	3.85	12.12	41.54	
Present	125	58	76	259
	96.15	87.88	58.46	
Total	130	66	130	326

Statistic	DF	Value	Prob
Chi-square	2	60.159	0.001
Likelihood ratio chi-square	2	63.576	0.001
Mantel-Haenszel chi-square	1	56.383	0.001
Fisher's exact test (2-Tail)			1.98E-14
Phi coefficient		0.430	
Contingency coefficient		0.395	
Cramer's V		0.430	

Sample size = 326

Table 10
Disk Attachment Pain
Table of Location By Group

Location / Frequency / Col Pct	Group CMD+B	CMD-NB	Control	Total
None	80	56	123	259
	61.54	84.85	94.62	
Present	50	10	7	67
	38.46	15.15	5.38	
Total	130	66	130	326

Statistic	DF	Value	Prob
Chi-square	2	45.032	0.001
Likelihood ratio chi-square	2	47.297	0.001
Mantel-Haenszel chi-square	1	43.420	0.001
Fisher's exact test (2-Tail)			5.44E-11
Phi coefficient		0.372	
Contingency coefficient		0.348	
Cramer's V		0.372	

Sample size = 326

symptoms and/or evidence of osteoarthrosis. The analysis of the results showed no statistical significant difference (p = 0.26) between patients and controls (**Table 13**). Again, observations did not show high incidence of the problem in the populations studied.

Table 9
Retrodiskal Pain
Table of Location By Group

Location / Frequency / Col Pct	Group CMD+B	CMD-NB	Control	Total
None	90	63	128	281
	69.23	95.45	98.46	
Present	40	3	2	45
	30.77	4.55	1.54	
Total	130	66	130	326

Statistic	DF	Value	Prob
Chi-square	2	52.639	0.001
Likelihood ratio chi-square	2	56.145	0.001
Mantel-Haenszel chi-square	1	46.535	0.001
Fisher's exact test (2-Tail)			6.76E-13
Phi coefficient		0.402	
Contingency coefficient		0.373	
Cramer's V		0.402	

Sample size = 326

Discussion

Frequency of Capsulitis/Synovitis

The frequency of capsulitis/synovitis in the CMD+bruxing behavior group was approximately 96.15% (125

Table 11
Disk Displacement With Reduction
Table of Location By Group

Location / Frequency / Col Pct	Group CMD+B	CMD-NB	Control	Total
None	79	48	94	221
	60.77	72.73	72.31	
Present	51	18	36	105
	39.23	27.27	27.69	
Total	130	66	130	326

Statistic	DF	Value	Prob
Chi-square	2	4.887	0.087
Likelihood ratio chi-square	2	4.846	0.089
Mantel-Haenszel chi-square	1	3.951	0.047
Fisher's exact test (2-Tail)			0.093
Phi coefficient		0.122	
Contingency coefficient		0.122	
Cramer's V		0.122	

Sample size = 326

Table 12
Disk Displacement Without Reduction
Table of Location By Group

Location	Group			
Frequency				
Col Pct	CMD+B	CMD-NB	Control	Total
None	122	66	130	318
	93.85	100.00	100.00	
Present	8	0	0	8
	6.15	0.00	0.00	
Total	130	66	130	326

Statistic	DF	Value	Prob
Chi-square	2	12.365	0.002
Likelihood ratio chi-square	2	15.015	0.001
Mantel-Haenszel chi-square	1	10.252	0.001
Fisher's exact test (2-Tail)			2.25E-03
Phi coefficient		0.195	
Contingency coefficient		0.191	
Cramer's V		0.195	

Sample size = 326

Warning: 50% of the cells have expected counts less than 5. Chi-square may not be a valid test.

Table 13
Osteoarthrosis
Table of Location By Group

Location	Group			
Frequency				
Col Pct	CMD+B	CMD-NB	Control	Total
None	117	61	124	302
	90.00	92.42	95.38	
Present	13	5	6	24
	10.00	7.58	4.62	
Total	130	66	130	326

Statistic	DF	Value	Prob
Chi-square	2	2.769	0.250
Likelihood ratio chi-square	2	2.850	0.241
Mantel-Haenszel chi-square	1	2.755	0.097
Fisher's exact test (2-Tail)			0.262
Phi coefficient		0.092	
Contingency coefficient		0.092	
Cramer's V		0.092	

Sample size = 326

patients) as compared to 87.88% (58 patients) in the CMD-nonbruxing behavior group and 58.45% (76 subjects) in the control group. Our results were very different from the frequency of 69% observed by Holmlund, Helssing and Axelsson[12] on clinical palpation of 62 temporomandibular joints of patients presenting chronic impairment of the TMJ function. This difference is probably related to the fact that all patients in our first group presented bruxing and/or clenching behavior which no doubt led to an overload of the joint capsule, thus resulting in trauma and inflammation. On the other hand, the prevalence (69%) these researchers found in their study was more similar to what we observed in our group of CMD-nonbruxing behavior patients (87.88%). The fact that we found a higher prevalence of capsulitis/synovitis in all three groups (bruxers, nonbruxers and controls), suggests that this disorder is probably multifactorial, and bruxing behavior per se is not its only cause.

Our results were very similar to the frequency of approximately 85% of capsulitis observed by Pereira, et al.[13] in their study of 27 patients presenting painful temporomandibular joints. Holmgren, Sheikholeslam and Riise,[14] used the clinical method of palpating over the temporomandibular joint and found a prevalence of approximately 75% capsulitis in patients presenting CMD and bruxing behavior. This difference is probably due to the fact that the group they examined had a lower mean age (27 years) as compared to our group of 130 CMD and bruxing behavior patients (35.48 years). There seems to be evidence from clinical studies that TMJ occurs more frequently in higher age groups. There is no data to compare the chronicity of this study's patients' disorders with that of these researchers. It is likely that a higher chronicity in this group may have also contributed to a higher prevalence of capsulitis/synovitis.

Lous, Sheikholeslam and Møller[15] examined a group of 39 CMD patients in the range of 14-70 years of age and even though they did not mention the percentage of bruxers in their group, they found a prevalence of about 97% capsulitis, being 54% unilateral and 43% bilateral. Such frequency is equivalent to what was found in this study (96.15%) in CMD+bruxers and 87.88% in CMD-nonbruxers). It is interesting to note that Marbach and coworkers[16] found only a small difference in the frequency of capsulitis between a group of 11 female CMD and bruxing behavior patients (54.5%) and another group of 134 female CMD-nonbruxing behavior patients (57.9%) suggesting that capsulitis/synovitis may be present significantly in CMD+ bruxer and CMD-nonbruxer patients. The difference in frequency between the group of 11 CMD+bruxing behavior female patients (54.5%) observed by Marbach, et al.[16] as compared to the frequency of about 96.15% observed in this study's group of 130 CMD+bruxing behavior patients may be due to the fact that those researchers used only a self-report to assess the presence of bruxing behavior, whereas in

this study self-report and various signs and symptoms which are no doubt associated with grinding/clenching the teeth were used.

Frequency of Retrodiskal Pain

Table 3 demonstrates that the frequency of retrodiskal pain was about 30.76% in the group of CMD+bruxer patients as compared to only 4.54% in the group of CMD-nonbruxer patients and 1.54% in the control group, therefore CMD and bruxer patients presented a significantly higher frequency when compared to the other two groups. It is difficult to compare our results with those of other researchers since literature regarding this disorder is scarce. Chosegros, et al.[17] studied the clinical results of therapeutic temporomandibular joint arthroscopy using a prediskal section and retrodiskal coagulation in 34 TMJs presenting debilitating joint disorders, mainly disk displacement with and without reduction that had not responded to noninvasive modalities of therapy. Lysis, lavage and retrodiskal coagulation were used as the therapeutic modalities. Even though the initial diagnosis was not retrodiskal pain, researchers observed objective improvement in 71% of cases which probably suggests that inflammation in the retrodiskal tissues was present before therapeutic intervention. Because many of these patients presented disk displacement without reduction, it was likely that the frequency of retrodiskal pain in this sample was higher as compared to the 30.76% found in this current study.

Kahnberg, Magnusson and Widmar[18] performed histopathological analysis of 28 disks in 28 patients who presented with anterior disk displacement without reduction (23 patients) and with reduction (5 patients). Only in 12 out of 28 disks, the posterior attachment was considered a part of the specimen taken for examination. The study demonstrated the presence of cellular signs of inflammation in the retrodiskal tissues in eight cases suggesting that 66% of this sample presented retrodiskal inflammation and pain before surgery. This higher prevalence of retrodiskal inflammation was probably associated with the high frequency of disk displacement without reduction (25 out of 28 disks) which was present in those patients. Sano and Westesson[19] studied the magnetic resonance imaging of the temporomandibular joint and the T2 signal in the retrodiskal tissues in painful joints so as to correlate it with pain. They studied 48 joints of 33 patients referred for MRI of the TMJ. Even though they did not establish the percentage of correlation, they concluded that the average T2 signal from the retrodiskal tissues was higher in painful joints than in nonpainful joints. Consequently, this and other studies suggest that a significant percentage of pain arising in the temporomandibular joint structures may be ascribed to the retrodiskal tissues. No doubt such pain is related to the inflammatory process. One of the most prevalent causes of inflammation and pain in these structures is chronic repetitive overloading combined with deficient protective mechanisms. Superficial vascular changes in the retrodiskal tissues are an aspect of the remodeling process during progressive anterior displacement of the temporomandibular joint disk. It is likely that many disk disorders occur together with an initial inflammatory change in the retrodiskal tissues.

Dworkin, et al.[20] studied the frequency of some temporomandibular disorders in clinical cases, community cases and community control subjects. By using intrameatal palpation, they found a frequency of about 10.2% pain in the TMJ which probably indicates the presence of retrodiskal pain. The lower frequency observed may be due to the fact that intra-meatal palpation can only produce mild or slight pain. Had they used the criteria utilized in this study to depict the actual frequency of retrodiskal pain, a higher frequency of TMJ intra-meatal pain may have been found. Also, not all patients in the Dworkin study were bruxers. The frequency found in the Dworkin study seems to be more similar to the 4.54% retrodiskal pain found in this study's group of 66 CMD-nonbruxer patients.

Since articular pain has been associated with fatty infiltration in other joints of the body (e.g., the knee articulation), Helmy, et al.[21] studied the histopathologic findings especially fatty changes that may be seen in surgical specimens from the TMJs in patients that have persistent pain after nonsurgical therapy. Helmy studied retrodiskal samples from 25 patients who had been previously treated unsuccessfully with splints for more than two months. Moderately dense tissue with cells, which appeared fibroblastic and intermittent chondrocyte type, were observed. Fatty changes, exclusively associated with the perivascular areas, were observed in 67% of 40 specimens. Because fatty infiltrations of the TMJ have been interpreted as degenerative changes and quinine and prostaglandin generated in the fat pads can pass freely in tissue fluid to adjacent areas, highly innervated structures may lead to joint pain. It is likely that such specimens presented retrodiskal inflammation and pain, or at least such changes could have been present before the degenerative changes ensued.

Takaku, et al.[22] performed a comparative MRI and microscopic pathology study of disk displacement without perforation in 11 patients. MRI was first performed and then diskectomy in 11 joints. On MRI assessments, high signal intensity in the posterior band of the disk and retrodiskal tissues was observed in 11 joints,

therefore suggesting retrodiskal inflammation and probably pain in 100% of cases. On microscopic examination, edematous changes were observed in retrodiskal tissues in seven joints (64%), suggesting retrodiskal inflammation. These and other studies, in which MRI, microscopy and/or a clinical method have been used to assess the functional status of retrodiskal tissues, suggest that the frequency of inflammation and probably pain in those structures is high, and therefore encourage other studies on this subject. The fact that a higher frequency of retrodiskal pain was found in this group of CMD+bruxing behavior patients (30.76%) as compared to the CMD-nonbruxing behavior group (4.54%) and controls (1.54%), implies that bruxing behavior probably renders posterior structures more vulnerable to ensue histological and biochemical changes that ultimately result in inflammation and pain. The functional status of such tissues should be assessed routinely in CMD and bruxing behavior patients.

Frequency of Disk-attachment Pain

Table 4 demonstrates that the frequency of disk-attachment pain in the CMD+bruxing behavior group was about 38.45% (50 patients) as compared to 15.14% (ten patients) in the CMD-nonbruxing behavior group and to only 5.39% (seven subjects) in the control group. Therefore, the frequency of this disorder was significantly higher in the CMD+bruxing behavior group as compared to the other two groups. The results were very similar to the frequency of 32% of disk-attachment pain found by Nitzan and Dolwick[23] in their study of 125 patients presenting internal joint derangements. Only 50% of the group they assessed were bruxers, thus the higher frequency observed in this study's group could probably be related to the fact that 100% in the group assessed were bruxers. Patients in the group evaluated by Nitzan and Dolwick[23] presented clicking, variable periods of limited mouth opening, intermittent locking, and jaw opening greater than 35 mm. Such patients were very similar in terms of clinical profiles when compared to those included in the current study's group.

Schiffman, et al.[9] used a combination of a questionnaire, clinical examination and bilateral tomography to refine the diagnosis of CMD patients. They found a frequency of 38% history of locking which could suggest disk-attachment pain. All patients presenting disk-attachment pain in our CMD+bruxing behavior group presented a history of locking and other signs and symptoms suggesting disk-attachment pain. Variable periods of locking usually occur with other signs and symptoms suggesting disk-attachment pain. Tsolka, Morris and Preiskel[24] assessed a group of 51 patients presenting signs and symptoms of CMD and found a frequency of about 34% history of locking which also suggests disk-attachment pain. The higher frequency found in the current study is probably related to the fact that all patients in the CMD+bruxing behavior group were bruxers and/or clenchers. There are many reports in the literature suggesting that repetitive micro-trauma to the posterior area of the temporomandibular joint structures does contribute to inflammation, anterior and medial disk displacement and signs and symptoms of disk-attachment pain.

Takahasi, et al.[25] assessed a group of 65 temporomandibular joints in 56 patients. They used clinical examination, history of signs and symptoms, panoramic and transcranial views, arthroscopy and MRI to establish a diagnosis. They found that 28 joints of 27 subjects (48%), presented internal derangements and a history of locking suggesting disk-attachment pain. The higher prevalence found in their study was probably associated with the more precise technique of assessment they used to examine patients and to refine the diagnosis. Patients presenting more disabling disorders, including disk-attachment pain and anterior disk displacement without reduction, are usually referred to more specialized centers in oral and maxillofacial surgery for examination and treatment. This could result in a higher prevalence of any of these disabling TMJ conditions.

Westling, et al.[26] studied a group of 76 female patients whose age ranged from 13 to 35 years old (mean 25.2 years), presenting CMD. Clinical criteria was used to assess the group which found a frequency of intermittent locking suggesting disk-attachment pain in about 23% of the group. The lower frequency found is probably related to the lower mean age of the group (25.2 years old) as compared to the current study's CMD+bruxing behavior group (35.48 years old) and to the fact that 100% of the group assessed in this study were bruxers. Only 57% of the group Westling studied were bruxers.

Frequency of Disk Displacement With Reduction

In this study, a frequency of 39.23% (51 patients) was found with anterior disk displacement (ADD) with reduction in the group of 130 CMD+bruxing behavior patients, and 27.27% (18 patients) in the group of CMD-nonbruxing behavior patients. Overall the data showed 35.20% of all 196 CMD patients (bruxers and nonbruxers) presented disk displacement with reduction. It is interesting to note that the frequency of this disorder in the control group (27.69%) was equivalent to that found in the CMD-nonbruxing behavior group (27.27%). The data suggests that a significant frequency of disk displacement with reduction can be found in subjects in a normal population. Because the prevalence of ADD with reduction was not

significantly different in all three groups (CMD+bruxers, CMD-nonbruxers and controls), it appears that bruxing behavior is not the determinant factor causing ADD with reduction. These findings need to be corroborated with other studies using similar samples. It is interesting to note that even though the controls were not seeking active treatment, there was a high frequency of anterior disk displacement in the group (36 subjects = 27.69%). The findings also suggest that ADD with reduction may be significantly high in asymptomatic individuals.

The frequency of 35.20% (196 CMD patients) ADD with displacement found in bruxers and nonbruxers is very different from the frequency of 71% ADD with reduction observed by Tsolka, Morris and Preiskel[24] in their study of 64 TMD patients of whom 40 were bruxers. Holmgren, Sheikholeslam and Riise[14] assessed a group of 31 patients presenting CMD and nocturnal bruxing behavior. They used a clinical method to diagnose ADD with reduction and found a frequency of about 26% reciprocal clicking suggesting ADD with reduction. This small difference in frequency is probably related to the different mean age of the group in the current study of CMD+bruxing behavior patients (35.48 years) as compared to the mean age of the group Holmgren, et al.[14] assessed (27 years) and also to the higher frequency of bruxing behavior of the group (100%) in the current study. Morrow[27] found a frequency of 44% of ADD with reduction in a group of 263 CMD patients. It is likely that the method of MRI used to depict disk position could account for the difference.

Kolbinson, et al.[28] assessed a group of 50 patients with a history of trauma and found a prevalence of about 54% ADD with reduction as compared to the 35.20% (196 patients) frequency observed in our group of 196 CMD patients (bruxers and nonbruxers). The higher frequency of the disorder these researchers observed is undoubtedly associated with the history of trauma of the patients in the group studied. A higher frequency of internal joint derangement (IJD) has been linked to a history of traumatic events.[29] Paesani, et al.[30] used MRI to depict the position of the joint disk in 230 joints of 115 CMD patients referred for diagnosis and treatment. Eighty percent (80%) of the group studied presented some form of IJD. Paesani observed a frequency of about 26% ADD with reduction which is almost equivalent to the frequency of 27.27% found in our group of 66 CMD-nonbruxing patients but little different from the frequency of 39.23% ADD with reduction observed in our group of 130 CMD+bruxing behavior patients. It is likely that the difference in frequency between the group those researchers evaluated and the group of CMD+bruxing behavior patients assessed here may be attributed to:

1. The lower mean age of the group Paesani, et al.[30] assessed;
2. The fact that all patients in the current study's group were CMD and bruxers;
3. The method of MRI Paesani used in the study versus the method of a questionnaire, clinical examination, palpation and stethoscope used to assess the patients in the current study.

An overall frequency of 35.20% ADD with reduction was found in our group of 196 CMD patients (bruxers and nonbruxers). This frequency is almost equivalent to the 39% of ADD with reduction observed by Lobbezoo, et al.[8] in a study of 438 patients presenting a diversity of signs and symptoms of CMD. Such similarity of results between that study and this one may be due to the similar age of the group assessed (34 years) and the comparable methods (questionnaire, clinical examination and history of signs and symptoms of CMD) used to evaluate the sample. The protocol was very similar to that used to evaluate our groups. Yatani, et al.[31] used clinical examination, medical and dental history, history of pain, palpation and assessment of mandibular movements plus sagittal tomography and MRI in one third of a group of 260 CMD patients to complement and refine diagnosis. They found a frequency of ADD with reduction of about 34.5% which is comparable to the frequency of 35.20% found in our entire group of 196 CMD patients (bruxers and nonbruxers). Holmlund, Helssing and Axelsson[12] assessed 62 temporomandibular joints of 55 CMD patients with a mean age of 43 years old. Clinical examination of this group depicted a frequency of 34% ADD with reduction which again is very similar to the frequency of 35.20% observed in the group of 196 CMD patients (bruxers and nonbruxers). Even though we only found a frequency of 45.39% ADD with and without reduction in the group of 130 CMD and bruxer patients, there is a report in the literature suggesting that bruxism is statistically linked to TMJ disk displacement which could explain the anatomic variation in abnormal disk position.[32]

Frequency of Disk Displacement Without Reduction

Table 6 demonstrates the frequency of disk displacement without reduction to be 6.16% (8 patients) in the CMD+bruxing behavior group. Such disorders were not observed either in the CMD-nonbruxing behavior group or in the control group.

This frequency was very similar to the seven percent (7%) of ADD without reduction observed by Lobbezoo, et al.[8] in a study of 438 CMD patients. Paesani, et al.[30] assessed 115 CMD patients and 230 joints by using clinical examination, arthrography and MRI to refine the diagnosis. A frequency of approximately 6.5% ADD

without reduction was found to be possibly associated with arthrosis.

The frequency of ADD without reduction observed in the current study was very different from the frequency of 60% found by De Laat, et al.[7] This difference in frequency may be related to the method of MRI used in their study and to the fact that patients in the sample were referred to a Department of Maxillofacial Surgery with a chief complaint of "limited mouth opening" which would reflect in a higher frequency of disk displacement without reduction and probably a history of disk-attachment pain. Patients presenting more chronic and disabling IJD and more pathological conditions of the stomatognathic system are usually referred to centers or institutions equipped with the state of the art equipment and facilities for diagnosis and/or treatment which includes oral surgery.

Frequency of Osteoarthrosis

In **Table 7** the frequency of osteoarthrosis (OA) in the CMD+bruxing behavior group was 10.01% (13 patients) as compared to the frequencies of 7.57% (five patients) in the CMD-nonbruxing behavior group and 4.62% (six subjects) in the Control group. As a whole, frequencies of OA in the three groups were very low and showed very little difference.

The results in this study were similar to the frequency of 11% crepitus suggesting osteoarthrosis observed by Wilkinson, et al.[33] in a group of 64 CMD patients. The higher frequency found was probably related to the high frequency of history of trauma in the group examined. Sixteen patients in the group presented a history of trauma. Westling, Carlsson and Helkimo[26] evaluated a group of 76 female CMD patients with a mean age of 25.2 years. Clinical examination was used to assess the patients and they found a frequency of approximately 11% of crepitus suggesting osteoarthrosis. Carlsson, Kopp and Wedel[34] evaluated a group of 350 consecutive CMD patients referred to the Department of Stomatognathic Physiology for diagnosis and treatment. The mean age of their group was 39.9 years. The questionnaire depicted a frequency of approximately eight percent (8%) crepitus suggesting osteoarthrosis. The frequency was very similar to that found in our study of CMD+bruxer patients (10.01%) and CMD-nonbruxer patients (7.57%). Marguelles, et al.[35] assessed a group of 484 patients presenting IJD in which 198 were females and the mean age of the group was 25.3 years. They found a frequency of about 8.6% crepitus during joint function, suggesting "degenerative arthrosis." The lower frequency observed in their group was probably associated to the lower mean age as compared to the higher mean age (35.48 years) of the group of CMD and bruxing behavior patients in the current study. Holmgren, Sheikholeslam and Riise[14] evaluated a group of 31 patients presenting symptoms of CMD and bruxing behavior. A stethoscope was used to assess joint sounds. Clinical examination, history of signs and symptoms and palpation were used to evaluate the symptoms of CMD. They found a higher frequency of crepitus (29%). Such a difference in frequency could probably be associated with the use of a stethoscope which is thought to significantly magnify joint sounds.

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